ANALYSIS OF DRY MILLING OPTIONS IN RWANDA

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Prepared by :

Chemonics International Inc.

Contrat n° PCE-1-807-00003-00

1113 20th Street, N.W.
Washington, D.C. 20036
USA

Rue du Lac Mpanga
B.P. 3582, Kigali
RWANDA.

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Objectives and Nature of Service Required

The objective of the consultancy is to weigh the advantages and disadvantages of purchasing a small dry mill or a larger jointly-owned mill verses paying a service fee for de-parching by established dry millers/exporters.

The specific tasks to be performed during the consultancy are as follows:

- Describe existing dry milling equipment and capacity in Rwanda. Discuss milling quality, current pricing strategy and transparency issues. Compare quality, prices and transparency with current situations in neighbouring countries.
- Identify changes that need to be made to render existing dry milling services more attractive to coffee washing station owners from both a quality and price standpoint.
- Identify dry milling equipment options which are suitable for small coffee washing stations (50 tons) and medium sized washing stations (200 tons) of parchment coffee per season.
- Identify equipment options for larger dry mills (parchment capacity of 600 tons) which could be jointly purchased by three or more washing station owners.
- Estimate the amount of consulting time required to install and commission different types of dry mills.
- Estimate capital investment costs and production costs of different options on a per ton basis.
- Compare the advantages and disadvantages (prices, timeliness, quality control) of installing different sizes of dry mills compared to using existing dry milling services.

Synthesis and conclusions

The objective of the report is to give ADAR all the required information on coffee dry milling options to advise the fully washed unit owners on processing their parched coffee before export. In spite of a particularly depressed coffee market, Rwandan investors are actively pursuing the development of production of high quality coffee for which there are still substantial opportunities for profit.

Rwanda's agricultural sector strategy is directed towards a strong development of coffee production to rebuild and modernize the old plantations and to promote the Fully Washed Coffee (FWC) through private investments. The objective is to develop Rwanda's coffee production in the long run by insisting on quality to increase revenue distribution in the country. The following table gives an indication of Government objectives.

Rwanda's strategy for coffee sector development

Year	**2002**	**2005**	**2010**
Production	20 000 t	30 000 t	44 000 t
% of fully washed coffee	< 5 %	20 %	63 %
Number of CWS	6	31	107

Since more than 50 % of coffee production in the long run will be characterized as FWC, it is important to organize all elements of the coffee production chain from plantation to the milling and grading processes before export, to make sure these conditions will in the end meet market requirements. This report is mostly concerned with the final processing of the fully washed coffee to appreciate the current services provided by milling units and to propose alternatives to economically improve the processing conditions of quality coffee.

A review of the existing milling units in the country shows :

1. **An excess capacity relative to actual coffee production**. The existing capacities distributed between the six largest millers / exporters total 45 tons of green coffee per hour which permit the processing of almost 52 000 tons per year (3 months at 16 hours/day).
2. **High curing losses relative to other countries**. An average of 23 % is observed when the norm should be of 18 to 20 %. The excess loss of 4 to 5 points means a reduction of revenue of 30 to 37 FRW per kg of processed coffee for the coffee owner. This loss is amplified by a high percentage of broken beans (up to 5 %) with a similar effect on the owner's income. These excess losses result from the following causes :
    - Low quality of parch coffee;
    - Poor maintenance of milling equipment;
    - Carelessness and weak discipline in coffee processing (processing of high moisture parched coffee...)
3. **Possibilities of milling and grading FWC as a specific service for washing units**:
    - In batches of 20 to 100 t to justify a discontinuity of the ordinary milling process to work separately with FWC;
    - For fees (bag not included) of 40 to 95 FRW/Kg of green coffee, with an average of 70 FRW/Kg;
    - Assuming all necessary efforts are made to guaranty transparency and tracking.

An alternative to use the existing capacities is for the Coffee Washing Stations (CWS) units to make their own investments to mill and grade their parched coffee. The study gives estimates of these investments including:

- Infrastructure, construction, access roads and electricity sources;
- Selection of appropriate equipment according to capacity and quality requirements.

For processing capacities of 50 t, 200 t, 600 t and 1 000 t, an evaluation of fixed and direct costs has been made which gives the following operating costs according to the level of activity and financial arrangements.

Production costs: Unit of 50 t capacity

Tons Cost/kg	20 t	50	100
Interest excl.	232	103	60
Interest incl.	354	152	85

Production costs : Unit of 200 t capacity

Tons Cost/kg	100	200	300
Interest excl.	67	42	34
Interest incl.	100	59	45

Production costs: Unit of 600 t capacity

Tons Cost/kg	200	600	1000
Interest excl.	68	34	27
Interest incl.	110	48	36

A comparison between milling options has to take into account not only the operating costs but also the curing losses and the rate of broken beans attached to each processing unit. A difference of curing loss of 1 % accounts for 7,5 FRW/Kg to be added (or subtracted) to the processing cost. The following table presents a cost comparison taking account of losses for the different options open to the Fully Washed Stations.

Comparison between milling options

Dry milling	Investment, cost MFRW	Milling cost, FRW/kg* (Exclud. Financ.)	Curling losses % **	Curling losses, FRW/k (Relative to 200 t)	Comparable cost (Exclud. Financ.)
Existing capacities					
Average service offered/kg		66,5	23%	37,5	104
(Minimum – Maximum)		(40-95)			
New investments					
- Unit of 50 t capacity	25	103	18%	0	103
- Unit of 200 t capacity	33	42	18%	0	42
- Unit of 600 t capacity	85	34	19%	7,5	41,5
- Unit of 1000 t capacity	85	27	19%	7,5	34,5

* Not including bags

** Curing losses slightly higher because of not so close management and also of the effects of bigger series

The conclusions to be taken from the analysis of the cost figures of milling and grading processes are:

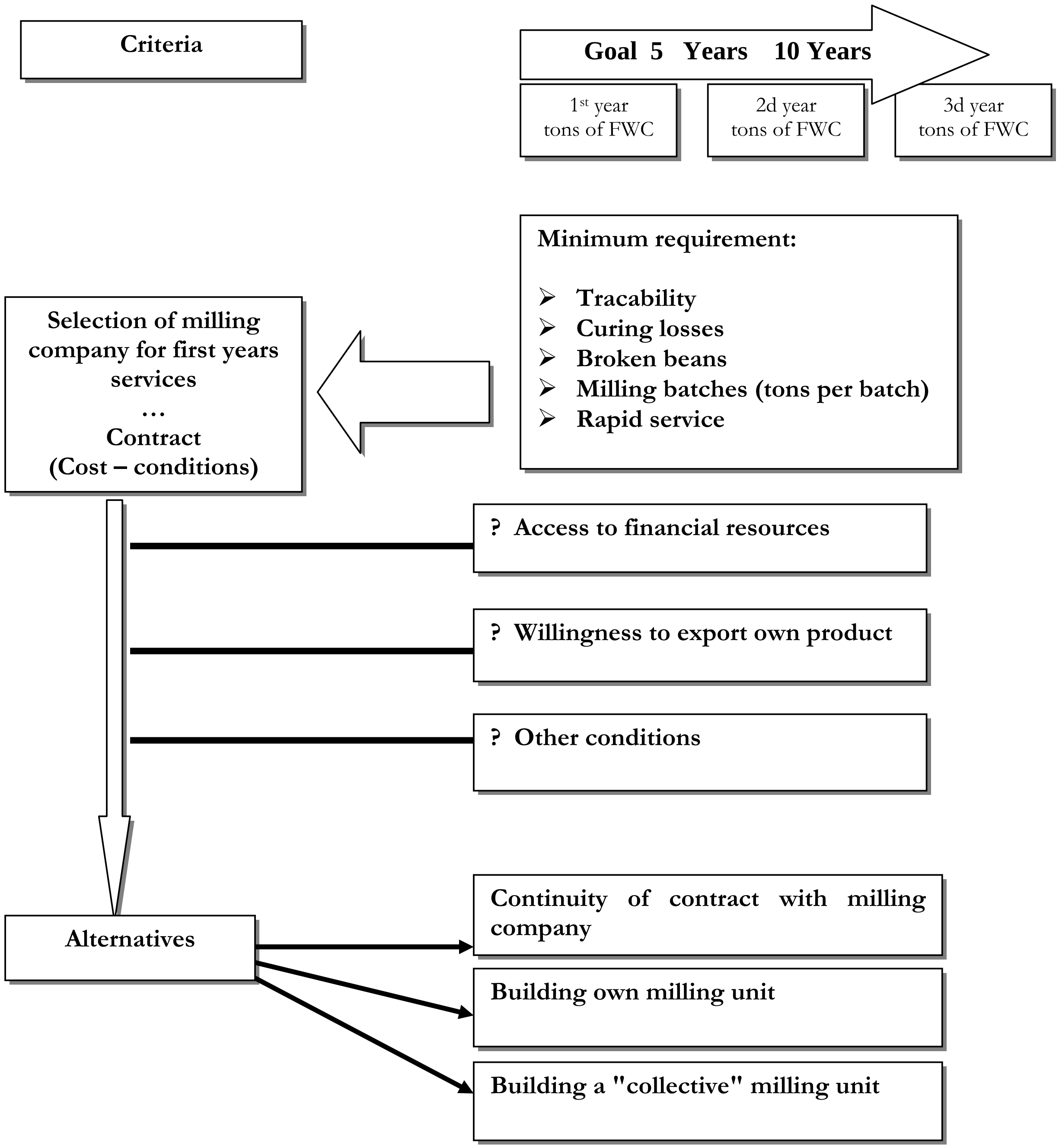
1. The average curing loss of existing mills is too high with a startling effect on overall processing cost. This loss level should be corrected to make the milling service cost competitive.

2. The small milling unit of 50 t per season does not appear very competitive with a milling cost superior to 100 FRW/Kg.

3. The processing units of 200 t, 600 t and 1 000 t capacity appear to be very competitive provided that the units are well managed and they function at capacity.

To give appropriate advice to the fully washed station relative to the processing of their parched coffee before export, it will be very advisable to proceed through a coherent approach, which is illustrated in the following graph.

RECOMMENDATIONS



A check list of questions and criteria should be established prior to making any decision relative to building a milling unit. The main points which should be addressed are:

- The washing unit production goal at the horizon of 5 and 10 years and the first three steps of the production program for the three first years.
- Consideration of the real quantities of FWC to be processed each year. The time generally needed to arrive at capacity (objective) is usually of three or more years for the fully washed stations.
- The minimum requirement defined for using existing milling capacities. Important points should be addressed such as:
    - Tracking of the fully washed product to guarantee the complete recuperation without alteration of the quality coffee;
    - Amount of curing loss considered as acceptable: more than 20 % curing losses is prohibitive;
    - Percent of beans broken during processing. An excess of 1% should be considered as high;
    - Unit batch of parched beans to be processed at a time. It should be adjusted to the need of the washing station and at the same time be acceptable by the processor;
    - Turn around time for coffee departchment;
    - A contract between the processing firm and the washing station should be signed which includes the minimum requirements agreed upon which are listed above.

A decision for selecting a specific dry milling option will depend upon the following answers to specific questions:

- Were prior relations with the existing mill satisfactory?
- Are there possibilities of accessing financial resources at a reasonable cost?
- Does the CWS owner want to export his own production?

Whatever the answers to these three questions, the consultants recommend a prudent approach to avoid costly mistakes. The proposed strategy is defined in two phases:

- 1st phase: During the first three years of operating the Fully Washed Unit, when the production remains below full capacity:
    - Enter in negotiation with existing milling units to buy the processing service according to the aforementioned criteria;
    - Bring the milling unit into competition, insisting more on service quality, and lower losses than on milling unit costs;
    - Develop, if possible, a good relationship with the selected milling unit for the three first year of CWS activity.

- 2nd phase: After three years experience with a milling station:

  - Decide if the relationship with the milling unit has given satisfaction to both parties and continue using the processing service of that unit.
  - Alternately, decide to create its own facility, building up a milling and grading unit adjusted to the washing station current and/or expected parched coffee production.
  - Select a third alternative, which would be to contract with several nearby washing units in order to build a shared milling unit, taking account of the group requirements in term of capacity and quality criteria.

1. Introduction

Coffee remains a leading crop in Rwanda in terms of local distribution of income and of foreign currency earnings. With an expectation of a crop of 20 000 t for 2003, the actual production is at a low level relative to the 35 000 t obtained prior to the civil war. Along with this decrease in production, coffee quality has slipped and the product no longer benefits from a premium on the world market.

In chronic excess, ordinary coffee on the world market receives less and less for standard grade product, diminishing drastically the price paid to farmers and reducing their interest in applying the technical recommendations to obtain more production of better quality. The recent market liberalisation of Rwanda's coffee sector has removed the buffer effect of government price fixing to link local transactions with farmers to price fluctuations in the world market of coffee.

The major coffee producing countries reacted these last years to the depressed price of ordinary coffee by developing specific chains of production of superior quality coffee for which the market is still paying a good premium. Presently, 20 % of the world coffee is sold at higher price as quality coffee: FWC (Fully Washed Coffee). Recently, Rwandan investors started to develop FWC but these initiatives still amount to less than 5 % of the Rwandese coffee production and will for the next years. This process of developing FWC is nevertheless gaining momentum with assistance of ADAR and other organisations helping investors to select the best options.

The investment process to produce good quality coffee for the world market applies at three levels:

1. The agronomic level with the introduction of new varieties and the application of controlled plantation techniques (weeding, fertilising, treatments, etc.);

2. The washing level, taking off the mucilage from sorted cherries, to produce the FWC which is a quality parched coffee;

3. The milling level, producing green coffee out of selected parched coffee, taking off the cellulose pellicle.

Producing a specific quality green coffee requires mastering the complete chain of production from the plantation to the milling stage. Nevertheless, this report is solely concerned by the last level of the production chain: the dry milling of the FWC.

To be more specific, the report will address the following issues of the dry milling process:

1. The evaluation of the existing capacities of milling equipment in the country;

2. An identification of the different options open to the FWC investors: using existing services, creating their own milling unit or pulling resources together to create a collective unit;

3. A comparison of the different options in terms of quality of services, of investment costs and operating costs, to help future investors in deciding the best option according to their specific situations.

This report has been elaborated to provide ADAR with a specific set of recommendations to advise its clients on investment options in dry milling coffee.

2. Existing capacity of milling equipment in Rwanda

2.1. Government strategy to revitalise the Rwanda coffee sector

The Rwandan government has the ambition to increase coffee production from 20 000 t in 2002 to 30 000 t in 2005 with fully washed high quality Arabica coffee [1] representing over 20% of total production. The projections shown in Annex 1 give the goal of 44 000 t by 2010, 63 % being fully washed high quality coffee.

From six existing washing stations in 2002, the projections call for 31 in 2005 and of 107 in 2010, which implies a substantial growth in private investment during the next years.

In order to obtain high prices on the international market, fully washed coffee must be correctly milled during the final step in green coffee production. Many investors have expressed concern about the quality, price and reliability of existing facilities and are tempted to install their own milling units.

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2.2. Capacity of milling units

The existing dry milling equipment found in Rwanda has a total milling capacity in excess of 50,000 tonnes of green clean coffee, of which only about 20,000 tonnes is being currently utilised. This leaves an unused milling capacity of about 30,000 tonnes.

In all, eight milling facilities were visited as shown in Table 1.

[1] A new strategy to revitalise Rwanda's coffee sector. Ministry of Agriculture, Animal Resources and Forestry. May, 2002. See in annex the graph of the Rwanda coffee projection (2002 – 2010).

Table 1. Existing coffee milling capacities in Rwanda

No.	Company	Capacity T/Hour	*Capacity T/Annum (4 months)	Grading x Weight	Grading x Size	Dryer	Colour Sorter
1	RWANDEX. Kigali	10	8,320	Catadors	Flat-bed	Yes	No
1a	RWANDEX. Butare (NOT VISITED)	8.3	6,906	?	?	?	No
1b	RWANDEX. Gisenyi (NOT VISITED)	18	14,976	?	?	?	No
2	SICAF. Kigali	3.6	2,995	Catadors	Flat-bed	Yes	No
3	CBC Coffee Business Center. Kigali	2.5	2,080	Gravity Table	Flat-bed	Yes	Yes?
4	AGRO-COFFEE INDUSTRIES. Kigali	4.5	3,744	Gravity Table	Flat-bed	Yes	No
5	RWACOF. Kigali	5	4,160	Gravity Table	Flat-bed	Yes	No
6	PEARL PROJECT. Butare	1	832	NONE	NONE	No	No
7	CAFERWA (Ex-CBC Milling Facility) Kigali	7.5	6,240	Catadors	Flat-bed	No	No
8	SEVEN LAKES: Masaka	1.8	1,498	Catadors	NONE	No	No
	Total Milling Capacities =	62.2	51,750				
	ESTIMATED Coffee Produced in Rwanda (2002) =		20,000 (According to OCIR)				
	Current excess milling capacity =		31,750	=	39%		
	*Capacity = 832 man days, based on:	4	Months x	8 hours/day x		26 days/month	

2.3. Equipment, yields and quality of operations

As can be seen from the table above, spare milling capacity, totalling over 30,000 tonnes currently exists in Rwanda.

The producers of **Fully Washed Coffee** in Rwanda require a special milling service to ensure that the extra high quality parchment coffee they have invested in producing and strived to obtain the highest quality has its quality maintained right through to the final curing.

Is such a high quality service available to them in Rwanda?

It was not possible during the period allotted to fully examine the milling machinery seen at the various factories to determine the quality of the final product that machines could produce.
Most of the mills visited had a full set of machinery as required to fully process Arabica parchment.
However, in some mills it was noted that processing machinery discrepancies existed.
These included:

- A higher than acceptable curing loss percentage, as high as 30% in one case;
- Unacceptable percentage of broken beans;
- Parchment coffee being milled with high moisture contents (as high as 13.8% at one mill);
- Worn machinery parts (such as very rough edges seen on some huller bars and huller cutting knives);
- Incorrect huller screens fitted (on *'John Gordon'* type machines) for milling Arabica.

It should be noted that the *'John Gordon'* type hullers should have a slotted (like a peaberry screen) screen fitted under the huller barrel. For milling Robusta cherry however, the screen should be changed for the woven-wire screen, which should have been supplied with the hulling unit.

Most mills were able to grade by weight using either catadors or gravity tables, but not all had facilities to grade by size, such as a rotary or flatbed vibratory grader.

Lower than acceptable yield and poor coffee quality are mainly due to the technical faults listed above.

2.4. Tracking and transparency

Prospective clients who are producing FWC have voiced concern about tracing and/or keeping a watch over their Parchment to ensure that it did not get 'lost' or mixed with coffee from other sources.

Virtually all the management of the coffee mills visited gave assurances that anyone bringing Fully Washed parchment to their mill for curing would be allowed to have one of their own employees stay in the mill and 'follow' their coffee through from beginning to end.

Several mill managers said that their Company would be happy to market the FWC after processing on behalf of a client.

They planned to pay an initial down payment for the coffee when milled and pay a percentage of the premium realised, if any, once the coffee had been bought.

Mill management gave assurances that any financial agreement that was entered into between a FWC grower and themselves would be fully transparent to ensure client satisfaction that a full and fair price had been paid.

This is perhaps a risky arrangement that can only be decided upon by the FWC owner himself.

2.5. Technical adjustment to improve milling quality and transparency

Most mills in Rwanda, if not all, should probably welcome the extra income available from milling outsiders' parchment coffee.

Several mills not only have all the necessary equipment to carry out perfect milling but also show signs of devoted management aiming for the production of a high quality final product.

It should prove a worthwhile venture for these mills to go out of their way to attract the Fully Washed coffee that is becoming more and more available for milling.

To belay any doubts from the minds of prospective clients regarding the milling quality being offered, a list of Essentials could be drawn-up by the client and gone through in detail with the mill manager, prior to any final decision being made.

The list could include some or all of the following points:

a. Probable curing loss/out-turn, (as a percentage) of the total Parchment to be milled and graded.
b. Guaranteed minimum percentage of broken beans to be acceptable by the client
c. Cost per kilogram of green coffee produced
d. Grades required (screen 18, 15, 13 plus pea berry?)
e. Availability of Grading by weight
f. Availability of Grading by size
g. Availability of accurate weighing and acceptable bag closing
h. Supply of suitable bags, by whom?
i. Disposal of 'lights' and triage.
j. A guarantee from the miller not to allow any mixing of the client's FWC with other coffee currently within the mill system.
k. The miller should indicate the minimum acceptable batch size he will accept per deal.

On the other hand, suppliers of FWC must ensure that their coffee has moisture content acceptable to the mill, of say 12% maximum.
The FWC should be clear of stones and rubbish and supplied in a clean condition.

A problem for milling companies may be that the timing of FWC to be cured may coincide with the mills maximum production period for its own product.

Further, the time needed to stop a current processing programme and clean out the coffee within the hullers/polishers, graders, elevators and conveyors etc, before introducing the FWC may prove too expensive with time and labour, nevertheless, this would have to be done, probably under the jurisdiction of the client.

2.6. Comparisons with neighbouring countries

A few years ago, ***Tanzania*** went through a similar trade liberalisation transition to what Rwanda is currently passing through.

Initially, the new entrants into the Tanzania (parchment) coffee purchasing system, were encouraged to utilise the country's three very large existing Arabica coffee curing mills, which had a massive available unused milling capacity.

However, dissatisfaction soon prevailed and within a very short period the private buyers, as they were referred to, were forced to seek an alternative outlet for milling their parchment.

The following constraints affecting coffee milling and costs were listed at that time:

- Milling return losses were comparatively high at most original mills in comparison to the new private mills.
- Original mills have received complaints about coffee being short weighed and misplaced at their mills.
- All original mills tend to have high operating costs, diminishing their ability to compete with the new private mills,
- The original milling factories maintain a two tier pricing system that meant that the private buyer had to pay a much higher levy to have his coffee processed. This lead to a disgruntled private buyer.
- Lack of finance for spare parts tempted factory managers to try to realise as much cash as possible from private clients regardless of the real value of the service being offered.
- A comparison of accepted overheads between the new private mills and the original mills indicated that the original mills operate on overheads of at least 35%. This could be one of several reasons inducing the original mills to charge a higher curing levy.
- It became apparent that the privately run factories operated more efficiently and with a far smaller work force and lower overheads, further reducing their overall curing cost.
- Grading facilities at some mills were grossly inadequate for the job.
- Old and run down coffee milling machinery compromised quality standards whilst also affecting throughput efficiency. This lead to high operating costs on a 'per kilogram' of green coffee milled, basis.
- Indifferent managers often allowed high moisture content parchment coffee into the factory for processing.

- Many factories use incorrectly calibrated and poorly maintained moisture meters resulting in false moisture content assessment.
- Costs for curing coffee at the original coffee mills averages about between Tzs 48/= to Tzs 58/= per kg (24 to 30 FRW) as compared to Tzs 12/= (6 FRW) at the new small privately run mini-mills. ($1 USD = Tzs 1,000).
- Curing losses at the new mini-mills ran at around 18% compared to up to 23% in the original mills.
- Broken beans were found to be negligible in the new mini-mills as opposed to up over 20% in the initial factories.
- Due to the above situation, 18 new privately owned mills shot up in less than two years.

3. Investment options in dry milling equipment

3.1. Infrastructure and construction for dry milling units

Preferably the dry milling units to be built will be constructed within the coffee production area, close to the washing units to reduce transport costs.

These milling units should have a good access to a good permanent road and to a sufficient supply of electricity.

The investment in infrastructure and building for each milling capacity will present the following characteristics as presented in table 2.

Table 2. Characteristics of infrastructure and building investments

Investment	Unit cost FRW / m2	Milling unit 50 t	Milling unit 200 t	Milling unit 600 t
Land	500	3 000 m2	5 000 m2	8 000 m2
Building	75 000	100 m2	150 m2	300 m2
Electrical connection	2 000 000	2 000 000 FRW	2 000 000 FRW	2 000 000 FRW
Road connection	1 500 000	1 500 000 FRW	1 500 000 FRW	1 500 000 FRW

3.2. Investment options in dry milling equipment

Most coffee curing mills worldwide usually make use of the following minimal essential processing machinery to ensure fully cured coffee:

{***OPTIONAL***: A mechanical drying unit complete with a pre cleaner and wet and dry storage bins optional}

- ***A pre cleaner (Vibratory flatbed or Rotary)***
- ***A de-stoner***
- ***Huller/s (Polisher… optional)***
- ***Grader – by size (rotary or vibratory flatbed)***
- ***Grader – by weight (catador or densimetric gravity table)***
- ***Weighing and bag sewing facilities***
- ***Various buffer bins/silos, elevators and conveyors, as necessary***
- ***Dust extraction system (Optional)***

{***OPTIONAL***: Bi or Tri-chromatic Colour Sorting machinery}

For Quality Control purposes, the following equipment should be considered:

- ***Moisture meter***
- ***Hand testing screen***
- ***Digital weighing scales***

Optional liquoring equipment, especially for the larger mills, should include:

- ***A small sample huller***
- ***An electric or gas fired mini-coffee roaster***
- ***A small coffee grinder***

Producers of Fully Washed coffee in Rwanda have invested much time and money in developing a superior product.

Only 20% of the total world's Arabica production is fully washed, and there is always a demand for this superior coffee, if it has been processed, from tree to cup, in the best possible way.

In Tanzania and Kenya, some producers of fully washed coffee have been able to realise a premium payment for their fully washed and fully graded green beans, sometimes as high as USD $500 per tonne.

There can be no bigger incentive for the producer than to receive a premium price for his coffee in these times of depressed coffee prices.

With the above in mind, the following options were looked into to see the pros and cons of using existing milling facilities against the installation of separate new mini-mills for individual or group producers of fully washed coffee.

An effort has been made to include all the very basic machines to enable the producer to not only be able to efficiently hull his coffee, but to also offer a way to fully grade his product.

The results are analysed below.

3.2.1. Small dry mill of 50 t / year

Equipment specification

The minimum machinery recommended is show below in Table 3.

Table 3 . Minimum machinery recommended

Item	Quantity	Machine details	Supplier's Cost CIF Mombasa	Total kW Needed
1		Manual Feeding		
2	1	AH4 Coffee Huller = 210kg/hr	$3,600.00	4.00
3		with motor and starter		
4	1	Gravity Table (Grades by weight)	$4,800.00	2.25
5	1	CSG-1 Size Grader (= 1 TPH)	$8,710.00	0.75
6	1	Sewing Machine	$1,175.00	0.40
7		Installation & Electrical materials	$1,000.00	
			$19,285.00	7.40
		Lighting, Office etc		2.00 KW
		Total Power required	**KWH1**	**9.40 KW**

The AH4 huller is a very efficient machine, which successfully removes most of the silver skin along with the husk, therefore making it unnecessary to incorporate a separate polisher. It has shown consistent curing losses of between 18% and 19% when milling clean parchment with moisture content below 12%.

During tests undertaken with the AH4 very low and consistent percentages of broken beans have been produced. (See Appendix 2 and 3)

With a parchment throughput capacity of 210 kg per hour, the machine can mill 50 tonnes of coffee in less than 5 weeks based on a 6-day week and an 8-hour day.

Should the producer wish to reduce the throughput time, by increasing the number of shifts worked per day this can easily be done.

A densimetric gravity table has been included to undertake grading by weight and a vibratory flatbed grader has been shown for grading by size.

The minimum recommended size of building should be about 10 m x 10 m.

Labour should include an Electrician/Mechanic who could probably also serve as a Supervisor, plus two machine operators.

Casual labour, say four people, would be required for weighing, stacking, emptying and re-filling bags.

The cost of belt transporters for only a small throughput will prove to be expensive.

The details relating to cost efficiency are looked into in more detail financial analysis in Chapter 5.

Consulting time

To install and commission the above equipment should take seven full working days as long as all necessary manpower and tools etc were available from the start. A list of recommended tools is shown in the Appendix of this report.

3.2.2. Medium dry mill of 200 t/ year

Equipment specification.

The minimum machinery recommended is show below in Table 4.

Table 4. Minimum machinery recommended for a dry mill unit of 200 t/year capacity

Item	Quantity	MACHINE DETAILS	Supplier's Cost CIF Mombassa	Total kW Needed
1		Manual Feeding		
2	2	AH4 Coffee Huller = 420kg/hr	$7,000.00	8.00
3		with motor and starter		
4	1	Gravity Table (Grades by weight)	$4,800.00	2.25
5	1	CSG-1 Size Grader (= 1 TPH)	*$8,710.00*	0.75
6	1	Sewing Machine	$1,175.00	0.40
7	1	Moisture Meter	$1,020.00	
8		Installation & Electrical Materials	$1,700.00	
		Total =	$24,405.00	11.40
		Lighting, Office etc		2.00 KW
		Total Power required	**KWH1**	**13.40 KW**

Two AH4 hullers have been recommended for this set-up with a total throughput of 420 kg of coffee per hour.

A parchment throughput of 420 kg per hour can mill 200 tonnes of coffee in about 10 weeks based on a 6-day week and an 8-hour day for 24 days per month.

Should the producer wish to reduce the throughput time, by increasing the number of shifts worked per day can easily be done.

A densimetric gravity table has been included to undertake grading by weight and a vibratory flatbed grader has been shown for grading by size.
The recommended minimum sized building should be about 10 m x 15 m.
An Electrician/Mechanic would be required and he/she could also serve as a Supervisor.
Two machine operators should be utilised.

About eight casually employed people would be required for weighing, stacking, emptying and re-filling bags.

Investment in individual dry mills could prove attractive if prevailing conditions such as good management, only clean dry parchment being processed and keen discipline with regards machinery operation to ensure losses do not exceed 18% to 19% overall were in place.

The financial analysis in Chapter 5 relates to the cost efficiency in more detail.

Consulting time

To install and commission the equipment recommended above should take nine full working days as long as all necessary manpower and tools etc. were available from day 1. A list of recommended tools is shown in the Appendix of this report.

3.2.3. Large dry mill of 600 t / year

Equipment specification

The processing costs of larger mills should prove lower per kilogram of green coffee produced than smaller processing units subject to their managers being able to provide a constant input of parchment which should be milled with all due consideration to quality and minimum losses and breakages.

One AH0 hullers has been recommended for this set-up with a total throughput of 1,800 kg of coffee per hour.

During tests undertaken with the AH0, low and consistent percentages of broken beans have been produced. (See Appendix 2 and 3)

A parchment throughput of 1,800 kg per hour can mill 600 tons of coffee in about 7 weeks and 1,000 tons in 12 weeks based on a 6-day week and an 8-hour day for 24 days per month.

Should the producer wish to reduce the throughput time, by increasing the number of shifts worked per day, this can easily be done.

A densimetric gravity table has been included to undertake grading by weight and a vibratory flatbed grader has been shown for grading by size.
The recommended minimum sized building for the production machinery should be about 10 m x 15 m plus two additional spaces (adjoining?) for incoming and final product stores of around 7.5 m x .10 m each.

A manager/supervisor should be recruited plus one Electrician and Mechanic.
Clerks would also be required to monitor the incoming parchment and final green coffee.
Five operators should be made available.

The financial analysis pages following relate to the cost efficiency in more detail.

The machinery recommended is show below in Table 5.

Table 5. Machinery recommended for a 600 to 1 000 dry mill capacity.

Item	Qty	MACHINE DETAILS	Supplier's Cost ex Works	Total kW Needed
1	1	Masonry intake hopper to be built locally	$0.00	
2	1	Bucket elevator ELS04040, 1,5 kw electric motor, to feed incoming parchment to the pre-cleaner	$1,720.00	1.50
3	1	Vibrating pre-cleaner PL-1 for parchment coffee, 0.5 kw electric motor, with aspiration of dust		0.5
		and light impurities at the product intake with 0.75 kw electric motor, and separation of impurities	$3,500.00	0.75
4	1	Bucket elevator ELS04040, 1,5 kw electric motor, to feed coffee to the destoner	$1,720.00	1.5
5	1	Destoner for coffee CP-1 to cope with hulling capacity, with 2.25 kw	$6,300.00	$2.25
6	1	Bucket elevator ELS04050, 1.5 kw electric motor, to feed clean parchment to the huller	$1,800.00	1.50
7	1	Coffee huller AH0: throughput capacity up to 1800 kg of Parchment/hr incl 30 kW motor + starter	$11,500.00	30.00
8	1	Bucket elevator ELS04050, 1.5 kw electric motor, to feed green coffee to the size grader	$1,900.00	1.5
9	1	Flat screens size grader CSG-30, 2.0 ton/h throughput for 7 grades	$12,000.00	1.5
10	4	Bucket elevator ELS04040, 0.75 kw electric motor, to feed 4 sizes of coffee to the buffer silo	$5,800.00	3.00
11	1	Metallic buffer silo TU-430, 12 tons of green coffee capacity, divided into 4 chambers	$7,200.00	
12	1	Bucket elevator to feed one size of coffee at a time to the densimetric separator	$2,700.00	1.5
13	1	Densimetric (gravity) separator flutu-ar MSD-50, w/ +turbine fan, 0.75 and oscillating system	$7,900.00	4.5
14	1	Bucket elevator ELS04040, 1,5 kw electric motor, to feed coffee to the bagging off silo	$1,720.00	1.5
15	1	Bagging off silo to bag coffee coming from densimetric separator, with high level alarm	$930.00	
16	1	Platform scale to weight up to 300kg x 100-gram gaps + wheels, fully mechanical	$270.00	
17	2	Manual sewing machine WPC, hand-held and operated, with	$1,025.00	0.8
18	2	One year period sewing machines spare parts = US$ 122.00 each	$200.00	
19	1	Dust suction fan to aspirate dust & impurities from 4 points, with cyclone to collect dust.	$2,750.00	2.25
20	1	Set of Interconnecting Materials for the plant above	$1,800.00	
21	1	Set of Spare Parts for two years operation of the grader and densimetric separator	$1,090.00	
22	1	Electrical control panel to switch on/off +starter overload, push buttons, emergency stop	$7,200.00	
23	1	Moisture meter G-600, digital electronic, for coffee and other grains	$920.00	
24	1	Huller for coffee samples DESCAM, + aspiration for husk and filter for clean air release	$700.00	
25	1	Set of hand operated samples grading screen, comprised of 15 screens and blind bottom	$310.00	
26	1	Roaster for coffee samples with 400W electric motor, 3 roasting drums for 300-gram-samples	$1,900.00	0.4
27	1	Belt bag conveyor/stacker x 9.00m long with heavy duty endless corrugated belt, reversible	$5,100.00	3.75
		TOTAL FOB PORT OF SANTOS - BRAZIL	**$83,655.00**	
		SEA FREIGHT (One 20' Container)	$8,800.00	
		INSURANCE	$978.00	
		CIF PORT OF MOMBASSA	**$93,433.00**	58.7
			Misc + Lighting, Office etc	20.00
			Total Power required	78.70

Consulting time

To install and commission the equipment recommended above should take 56 full working days. All necessary manpower and tools etc should be made available from the start.

4. Investment costs, unit costs and basic financial data

4.1. Economic and financial framework

4.1.1. Local bank loan conditions

The exchange rate of the Rwandese Franc (FRW) relative to US$ is currently 520 FRW for 1 US$. This rate is shifting from one year to the other by about 10 % (last 4 years) making the FRW cheaper relative to US$ and other foreign currencies. There is no transfer restriction of business profits from the country, and the access to foreign currencies is guaranteed by an important reserve (7 months of importation) managed by the BNR.

The rate of inflation is officially at 6 %.

The base lending rate of the BNR is presently of 13%. The **rate of interest on interbank loans** is nevertheless less than 10 %; the local banks being generally over liquid.

Bank bonds are remunerated at 5 % to 8 % according to their terms from 3 to 12 months.

Rates of interest offered by local banks for short and medium term loans are:

- Medium term of 4 to 7 years with 1 year reimbursement delay, to finance investments: 16 % almost exclusively accessible at the BRD (Banque Rwandaise de Développement) on credit lines. Guaranty required: mortgage of fixed assets on the principal plus 3 year interest.
- Short term up to one year, to finance :
  - Bank facilities: rate of 15 – 18 %
  - Import and storage transaction: rate of 15 – 18 %
  - Coffee buying loan: rate of 14 – 15 %.

Guaranty for bank facilities and import and storage transactions are taken by mortgage registration of fixed capital goods. For the coffee loans, the guaranty is limited to a warrant of coffee stocks in OCIR storage facilities.

Banking fees for services are:

- Importation: validation of licence: 5 000 to 10 000 FRW
- Export licence validation: 3 000 FRW
- Documentary credit: 0,2 to 0,30 % /quarter
- Transfer fees: 1 %

4.1.2. Local tax system

Value Added Tax (VAT) on all good and services (with compensation and tax return) 18 %;
Tax on business profit (on net profit on the basis of annual declaration) 30 %;
Tax on distributed salaries: - Non permanent labour: 15 %;
- Permanent labour: according to salary level and family conditions

Border tax:

- Small equipment 5 %
- Industrial equipment 5 %
- Transport equipment: Small cars: 25 %
  Trucks: 5 %
  Spare parts: 15 %
- Fuel: 25 % + 60 % consumer tax.

4.1.3. Facilities and incentives

The Rwanda Investment Promotion Agency can provide facilities and incentives to any investor intending to make new investments, rehabilitate, expand, renovate or restructure existing enterprises of the following magnitude:

1. Import tax on plant, machinery and equipment with border tax of 0 %: zero % sales tax;
2. Single flat fee in % of CIF value of imported items with border tax > 0 %: 5 % sales tax;
3. Investment allowances of 30 % of the value of invested capital during the first year of operation;
4. Fiscal incentives provided by the law N° 8/97 on direct taxes on profit and professional income;
5. Additional deduction from taxable income of 50 % of training, research and product development costs;
6. The right to fully expand the cost of providing infrastructure to the site of the business operations and tax free export operations;
7. Duty draw back for all duties and taxes paid on imported raw materials for exported finished goods.

4.2. Investment costs, amortisation and maintenance

The amortisation and maintenance costs are calculated according to the basic rules presented in Table 6.

Table 6. Ratio used to calculate amortisation and maintenance provisions

Investment	Life span	Depreciation rate	Maintenance rate
Land	-	-	-
Electrical connection	25	4 %	-
Road connection	25	4 %	5 %
Building	20	5 %	3 %
Heavy equipment	15	6.66 %	Specified
Light equipment	5	20 %	5 %

4.3. Unit costs of inputs

4.3.1. Labour

Table 7. Labour cost for permanent employees, FRW/month

	Worker	Supervisor	Accountant	Assistant	Manager
				Manager	
Base salary	15.000	30.000	52.000	75.000	150.000
Housing	5.000	23.000	50.000	50.000	100.000
Transport	2.000	5.000	10.500	10.500	50.000
Total gross salary	**22.000**	**58.000**	**112.500**	**135.500**	**300.000**
TPR employee contribution	390	6.350	19.500	23.487	52.000
CSR 3% employee contrib.	600	1.590	3.060	4.065	9.000
Net salary	**21.010**	**50.060**	**89.940**	**107.948**	**239.000**
CSR 5% firm contribution	1.000	2.650	5.100	6.775	15.000
Labor cost to firm	**23.000**	**60.650**	**117.600**	**142.275**	**315.000**

Table 8.: Labor cost for non permanent labour, FRW/day work

Daily salary	500
Tax on occasional labor	75
Total daily labor cost	**575**

4.3.2. Electricity and water

Table 9 : Electricity and water, FRW/unit

	Fixed cost/month		KWH or m³	VAT	Unit cost
Electricity - KWH	200		42	8	**50**
Water - M3			150	27	**177**

4.3.3. Fuel

Diesel oil : 439 FRW /liter.

4.3.4. Transport

Table 10: Transport cost, FRW/ton

	Km	Total cost	FR/ton/km		
Local transport					
- Cyangugu - Kigali	300	20000	67		
- Butare - Kigali	135	12000	89		
- Shory distance (< 50 km)			90		
International transport		**transport**	**transit**	**FOB**	**FRW/ton**
- Kigali – Mombasa (coffee in container)		42640	21840	64480	88400
- Mombasa – Kigali (equipments in container)			Minimum (1) Maximum (2) Average		88400 148200 118300

(1) Minimum of 15 tons
(2) 10 tons per container

The transport taken into consideration here concerns the green coffee from the milling unit to the OCIR storage facility. As a hypothesis, the distance is fixed at 25 Km.

The transport cost per ton of green coffee will be of : 90 FRW x 25 = **2 250 FRW**

4.3.5. Conditioning of green coffee

To condition the green coffee for export, jute sacs of 60 Kg will be used. The cost of sacs including printing and sewing materials is estimated at 600 FCFA per unit. The conditioning direct cost per ton of green coffee is then: **10 000 FRW.**

4.3.6. Insurance

Minimum insurance requested to cover bank loans is the fire insurance on building and equipment. The premium rate is calculated as follows:

- Premium rate: 2.5 per 1 000 of the value of building and equipment
- File cost: 1000 to 6000 FRW.
- VAT: 18 %.

The same insurance will cover the fire risk on coffee stocks. Usually the milling unit manager will ask for coverage of what he has in store at the time. Coverage of 25 % of the volume corresponding to his annual milling activity will take care of the risk (the Kg being estimated at 750 FRW).

4.3.7. Taxes

The import taxes on equipment of 5 % are included in the cost of this equipment.

The VAT of 18 % on local costs of goods and services is not taken into account as a cost, since the milling unit recovers that tax in the process of exporting the green coffee. Tax recovery may take from six months to one year's time.

The tax of 15 % on casual labour is included in the cost of labour.

The consultant's objective being to make comparison between milling alternatives, there is no real interest on taking track of taxes paid on specific expenses and on net revenues

4.3.8. Management and external services

We estimate the cost of other external services as:

- 500 000 FRW for a unit of 50 T annual capacity;
- 1 000 000 FRW for a unit of 200 T annual capacity;
- 2 000 000 FRW for a unit of 600 T annual capacity.

4.3.9. Financial cost

The following hypotheses are used to calculate the financial cost of the investment.

- The milling unit will benefit from a medium term loan covering 60% of the investments, at an interest rate of 16%
- This loan does not concern coffee buying which should be considered separately. It will apply annually on a six month span of time.

The need in working capital is estimated in Table 11.

Table 11. Basic ratio to calculate the need for working capital

Cost figure	% Taken in working capital need
Labour cost of permanent labour	100 %
Casual labour	100 %
Maintenance of infrastructure and equipment	50 %
Conditioning (sacs)	100 %

For an investor who disposes of the total amount of capital required to build and operate his own milling unit, the financial cost will be considerably lower. Nevertheless, an opportunity cost of capital should be used to take into account the other opportunities of investment proposing alternative return at low risk. The local banks are proposing to investors short term bonds at 8 % interest rate. This rate could be considered as the opportunity cost of investing in the coffee milling sector.

5. Processing costs per ton of green coffee

5.1. Milling services of existing capacities

5.1.1. Existing available capacities

Six companies licensed to export Rwandese coffee are presently equipped to dry mill the parched coffee in Rwanda. The overall capacity of the working milling units is generally much above the tonnage of coffee they are annually processing. Table 12 gives an approximate review of the existing capacities relative to the quantities processed during the last season.

Table 12. Existing processing capacities of coffee milling equipment in Rwanda, in tons of Green Coffee

Milling company	Present milling capacity: t/hour *	Last processing data	Disposable capacity
RWANDEX – Kigali	27 t*	9 000 to 10 000 t	21 000 t (68 %)
C.B.C. – Kigali	3 t*	No activity	3 456 t (100 %)
Agrocoffee Industries Kigali	3 t	3 480 t	264 t (7 %)
CAFERWA – Kigali	4 t	Restructuring	6240 t (100 %)
RWACOF – Kigali	5 t*	5 200 t	0 t (0 %)
SICAF - Kigali	3 t*	600 t	2 395 t (80 %)
Total	**45 t / hour**	**18 780 t**	**33 355 t (63 %)**

* Source: OCIR-Café.

5.1.2. Proposition of milling services to washing units

Since the current over capacity of the milling units is already very high, no export company is wants to see it increased by installation of new milling units closely related to Fully washed investments. To avoid new investment in the milling sector, they are offering milling services to washing units.

Two levels of services are offered:

- A simple milling service providing curing, grading and bagging to the washing units. The sale of green coffee being made by other accommodations;
- A service of curing, grading and bagging completed by the handling of all the trade services to export the coffee.

Whatever the service selected by the washing units, the transparency of the operation (tracking) can be guaranteed for lots of 15 tons at the minimum.

Table 13 gives the main contracting conditions for the services offered by the milling companies to the Washing units.

Table 13. Milling Services offered to Fully Washed Coffee Units

Milling Cy	Capacity offered (t)	Current yield G.C./P.C. %	Broken coffee %	Milling price FRW/Kg *	Milling + Trading conditions
Rwandex	No limit Minimum 15 to 20 t	78 %	6 %	90 FRW	Milling = 93 FRW Trading profit distrib. <500 t : 93 % of profit to the Washing unit. 500 – 700 t : 94 % > 700 t : 95 %
C.B.C.	1 000 t minimum 15 t	Not operating yet	No data	57 FRW	Milling = 57 FRW Trading < 200 t : 90 % of profit to the Washing unit.
Agro-Coffee Ind.	500 t minimum 100 t	77.3 %	5 %	60 - 70 FRW	Possible Conditions not specified
CAFERWA	2500 t	72 %	?	45 FRW	Contract with UPROCA. Milling = 45 FRW Trading: 30 % of profit to the co-operative.
RWACOF	1 000 t	76 %	4 %	90 – 95 FRW	Possible Conditions not specified
SICAF	1 000 t	80 %	?	No price specified	Possible Conditions not specified
Total Average		**77 %**	**5 %**	**70 FRW**	

* Milling price in FRW / Kg of green coffee returned to the Washing Unit. Bags not provided.

To develop a reliable milling service price list, the consultant asked for a break down of milling costs which the milling units were very reluctant to provide. The milling conditions presented in the table are indicative prices to be considered as a basis for future negotiations between milling company and coffee washing units.

As can be seen in the above table, the milling prices offered to Full Washed Coffee units vary greatly from one service provider to the other although the quality of services should not be very different (after complementary investments advised by the technical consultant to improve yields). The disparity of proposed prices is explained by the following observations:

- A poor knowledge of the real cost of milling by most of the milling managers;
- A different point of view on the way to compete to provide milling services to FWC units. The RWANDEX manager considers that his leading position on the local market allows him to request a price close to the average milling cost of its enterprise, taking into account the excess cost resulting from excess capacity. The other coffee milling units propose a much more competitive price covering only estimates of marginal costs in order to get part of the service market.

They consider that a fuller use of their milling capacities will contribute to reducing the average milling cost and improve their overall situation.

- A lack of experience of the milling companies about competition as a way to improve their market position. A few years of competitive bidding to process fully-washed coffee should help provide more consistent data on cost figures and on effective quality services. It will contribute to clarifying and probably reducing the number of milling service providers to a smaller number of well-managed companies.

5.2. Milling cost relative to investment options

The layout and the equipment specifications of the 50 t milling capacity are presented in 3.2. This unit can work up to 100 t or more of green coffee per season. The small capacity justifies a manual feeding of the machinery, which explains the low investment level. It gives at the end a good service, providing a graded coffee which meet the normal buyer specifications, with curing losses and broken beans conform to the norm: between 18 % and 19%.

5.2.1. Unit of 50 t capacity

Investment

The investments to be made for a small milling unit include land, construction, road and electrical connections and fully installed equipment. Table 14 gives the investment figures. It also provides the calculated annual depreciation cost and an estimation of the annual maintenance cost.

Table 14. Investments to create a small coffee mill unit of 50 t capacity

Unit of 50 t	**Unit cost**	**Surface**	**Price FRW**	**Amortisation**	**Maintenance**
Infrastructure					
Land (m^2)	500	3.000	1.500.000		
Electricity connection			2.000.000	80.000	
Road work			1.500.000	60.000	75.000
Building (m2)			7.500.000	375.000	225.000
Total infrastructure			**12.500.000**	**515.000**	**300.000**
Heavy equipment					
Milling equipment CIF Mombasa			9.417.200		
Transport to Kigali (one container)			1.482.000		
Tax (5%)			544.960		
Total milling equipment			**11.444.160**	**762.944**	**312.000**
Light equipment					
Light equipment			611.000		
Office equipment			500.000		
Tax (5%)			55.550		
Total light equipment			**1.166.500**	**233.310**	**58.328**
Grand total			**25.110.710**	**1.511.254**	**670.328**

Operating costs

The operating costs are calculated on the basis of unit costs presented in Chapter 4. They have been split in fixed costs, unrelated to the actual use of the milling capacity, and variable costs, in proportion to the effectively used capacity. Table 15 presents in detail the operating costs for a small milling unit.

Table 15 - Operating costs of a small coffee-milling unit of 50 t capacity, FRW

			US$ 1 =	520	
Activity level : tons of green coffee	50	tons G.Coffee		Value /kg =	750
Investments	25110710	% bank loan	60%		
Working capital	1019164	% bank loan	60%		
Dry milling costs	**Unit cost**	**Quantity**	**Cost value**	**in % of total**	**FRW / kg**
Fixed costs					
Permanent labor / month					
- Manager (part time 50 %)	315000	2	630000	12	13
- Assistant manager and engineers	142275	4	569100	11	11
- Accountant	117600	0	0	0	0
- Supervisor	60650	4	242600	5	5
- Permanent worker	23000	4	92000	2	2
Amortisation			1511254	29	30
Maintenance			670328	13	13
Insurance			91214	2	2
Management and services			500000	10	10
Sub-total fixed costs			4306496	83	86
Variable costs					
Occasional labor (day of 6 hours effec	575	160	92000	2	2
Electricity / ton	1980	50	99000	2	2
Sacs / t	10000	50	500000	10	10
Transport / t	2250	50	112500	2	2
Fuel				0	0
Other variable costs	1000	50	50000	1	1
Sub-total variable cost			853500	17	17
Total cost (without financial cost)			5159996	100	**103**
Financial cost			2459548		49
Total cost (including finances)			**7619544**		
Milling cost per Kg of green coffee			**152**		
Opportunity cost of using his own capital			1229774		
Milling cost per Kg, opportunity cost included			**128**		

Working at full capacity, the operating costs per Kg of green coffee are :

- Cost excluding bank interest: 103 FRW / Kg;
- Cost including local bank interest: 152 FRW / Kg;
- Cost estimate using opportunity cost on capital: 128 FRW / Kg.

Sensitivity analysis and conclusions

The small milling unit will process the parched coffee produced by a small CWS. It may operate at full capacity, but for a transitory phase this capacity may be used below its standard, and later on over its standard. Milling costs per Kg will vary greatly as a function of capacity used, as shown in the table 16.

Table 16 - Sensitivity analysis of using the milling capacity, Unit of 50 t

Tons of green coffee Milling cost FRW/Kg	20 t	30 t	**50 t**	75 t	100 t	150 t
Financial cost excluded	232	160	**103**	75	60	46
Financial cost included	354	242	**152**	108	85	63

The small coffee milling unit presents little interest for the CWS for the following reasons:

- High operating cost per Kg using full capacity;
- High sensibility to the capacity level used:
  - Prohibitive cost for less than 30 t of processed coffee per year;
  - Acceptable cost for 100 t or more of processed coffee per year.

At the outset, it may occasionally operate at full capacity but, during the first few years of operation, it will likely be used at under capacity, then, thereafter, at overcapacity.

5.2.2. Medium dry mill unit of 200 tons capacity

The layout and the equipment specifications of the 200 t milling capacity per season are presented in 3.3. This unit can work up to 400 t of green coffee per season. At capacity, the unit can be used with a manual feeding of the machinery, which explains the low investment level. It gives at the end a good service, providing a graded coffee which meets the normal buyer specifications, with curing losses and broken beans conform to the norm: 18 % to 19%.

Investments

The investments for the medium milling unit include land, construction, road and electrical connections and equipment fully installed. Table 17 gives the investment figures. It gives also the calculated annual depreciation cost and an estimation of the annual maintenance cost of building and equipment.

Table 17 - Investments to create a medium sized coffee mill of 200 t capacity

Unit of 200 t	Unit cost	Surface	Investment	Amortisation	Maintenance
Infrastructure					
Land (m2)	500	5000	2500000		
Electricity connection			2000000	80000	
Road work			1500000	60000	75000
Building (m2)	75000	150	11250000	562500	337500
Total			**17250000**	**702500**	**412500**
Heavy equipment					
Milling equipement CIF Mombasa			11549200		
Transport to KigaLi (one container)			1482000		
Tax 5 %			651560		
Total milling equipement			**13682760**	**912184**	**416000**
Light equipment					
Light equipment			1141400		
Office equipment			750000		
Tax 5 %			94570		
Total Light equipment			**1985970**	**397194**	**99299**
Total			**32918730**	**2011878**	**927799**

Operating costs

The operating costs are calculated using unit costs presented in Chapter 4. They are split into fixed costs, unrelated to the actual use of the milling capacity, and variable costs, in proportion to the effectively used capacity. The Table 18 presents in detail the operating costs for a medium capacity milling unit.

Table 18. Operating costs of a coffee milling unit of 200 t capacity,FRW

			US$ 1 =	520	
Activity level : tons of green coffee	200	tons G.Coffee		Value /kg =	750
Investments	32918730	% bank loan	60%		
Working capital	2923899	% bank loan	60%		
Dry milling costs	**Unit cost**	**Quantity**	**Cost value**	**in % of total**	**FRW / kg**
Fixed costs					
Permanent labor / month					
- Manager (part time 50 %)	315000	2	630000	7,5	3,2
- Assistant manager and engineer	142275	4	569100	6,7	2,8
- Accountant	117600	0	0	0,0	0,0
- Supervisor	60650	4	242600	2,9	1,2
- Permanent worker	23000	4	92000	1,1	0,5
Amortisation			2011878	23,8	10,1
Maintenance			927799	11,0	4,6
Insurance			181047	2,1	0,9
Management and services			500000	5,9	2,5
Sub-total fixed costs			5154423	61,1	25,8
Variable costs					
Occasional labor (day of 6 hours eff	575	640	368000	4,4	1,8
Electricity / ton	1350	200	270000	3,2	1,4
Sacs / t	10000	200	2000000	23,7	10,0
Transport / t	2250	200	450000	5,3	2,3
Fuel				0,0	0,0
Other variable costs	1000	200	200000	2,4	1,0
Sub-total variable cost			3288000	38,9	16,4
Total cost (without financial cost)			8442423	100,0	**42,2**
Financial cost			3300545		16,5
Total cost (including finances)			**11742969**		
Milling cost per Kg of green coffee			**59**	FRW / Kg Green coffee	
Opportunity cost of using his own capital			1650273		
Milling cost per Kg, opportunity cost included			**50**		

Working at full capacity, the operating costs per Kg of green coffee are :

- Cost excluding bank interest : 42 FRW / Kg;
- Cost including local bank interest : 59 FRW / Kg;
- Cost estimate using opportunity cost on capital: 50 FRW / Kg.

Sensitivity analysis and conclusions

The milling unit of 200 t capacity per year offers a processing service in line with ultimate CWS production goals. It may operate using full capacity, but at the outset, production is likely to be under projections. The outcome in term of milling costs per Kg will be much affected by the level of capacity used, as shown in the Table 19.

Table 19. Sensitivity analysis of using the milling capacity, unit of 200 tons

Tons of green coffee Milling cost FRW/Kg	50 t	100 t	150 t	**200 t**	250 t	300 t
Financial cost excluded	118	67	51	**42**	37	34
Financial cost included	182	100	72	**59**	50	45

The medium coffee milling unit presents an attractive option for the washing units, as an alternative to the use of existing milling services from export operators, for the following reasons:

- Relatively low investment (33 M.FRW) because of simple layout using manual equipment feeding techniques;
- Reasonable cost when using full capacity (200 t);
- High sensibility to the capacity level used:
  - Prohibitive cost for less than 200 t of processed coffee per year;
  - Low cost for 300 t of processed coffee per year, but at this level additional investments in product handling equipment such as conveyor belts should be considered.

5.2.3. Large dry mill unit of 600 tons capacity

The layout and the equipment specifications of the 600 t milling capacity per season are presented in 3.4. This unit can work up to 1200 t of green coffee per season. At capacity, the unit uses a set of mechanical feeding apparatus and intermediate silos to obtain the best outcome. Such a mill will provide the right service to a group of several washing units installed in the area. It provides a graded coffee, which meets the normal buyer specifications, with curing losses, and broken beans conform to the norm: 19 %.

Investments

The investments for the 600 t milling unit include land, construction, road and electrical connections and equipment fully installed. The Table 20 gives the investment figures. It gives also the calculated annual depreciation cost and an estimation of the annual maintenance cost for building and equipment.

Table 20 - Investments to create a coffee milling unit of 600 t capacity

Unit of 600 t	Unit cost	Surface	Investment	Amortisation	Maintenance
Infrastructure					
Land (m2)	500	8000	4000000		
Electricity connection			2000000	80000	
Road work			1500000	60000	75000
Building (m2)	75000	150	11250000	562500	337500
Storage building	50000	150	7500000	300000	225000
Total			**26250000**	**702500**	**412500**
Heavy equipment					
Milling equipement CIF Mombasa			50849760		
Transport to Kigali (one container)			2964000		
Tax 5 %			2690688		
Total milling equipement			**56504448**	**3766963,2**	**1040000**
Light equipment					
Light equipment			1011400		
Office equipment			1500000		
Tax 5 %			125570		
Total Light equipment			**2636970**	**527394**	**131849**
Total			**85391418**	**4996857**	**1584349**

Operating costs

The operating costs are calculated using unit costs presented in Chapter 4. They are split into fixed costs, unrelated to the actual use of the milling capacity, and variable costs, in proportion to the effectively used capacity. The Table 21 presents in detail the operating costs for a 600 t capacity milling unit.

Table 21 - Operating costs of coffee milling unit of 600 tons capacity, in RWF

Milling unit of 600 t capacity			US$ 1 =	520	
Activity level : tons of green coffee	600	tons G.Coffee		Value /kg =	750
Investments	85391418	% bank loan	60%		
Working capital	7907674	% bank loan	60%		
Dry milling costs	**Unit cost**	**Quantity**	**Cost value**	**in % of total**	**FRW / kg**
Fixed costs					
Permanent labor / month					
- Manager (part time 50 %)	315000	4	1260000	6,2	2,1
- Assistant manager and engineer	142275	4	569100	2,8	0,9
- Accountant	117600	4	470400	2,3	0,8
- Supervisor	60650	4	242600	1,2	0,4
- Permanent worker	23000	20	460000	2,3	0,8
Amortisation			4996857	24,6	8,3
Maintenance			1584349	7,8	2,6
Insurance			499729	2,5	0,8
Management and services			500000	2,5	0,8
Sub-total fixed costs			10583034	52,1	17,6
Variable costs					
Occasional labor (day of 6 hours eff	575	1140	655500	3,2	1,1
Electricity / ton	1880	600	1128000	5,6	1,9
Sacs / t	10000	600	6000000	29,5	10,0
Transport / t	2250	600	1350000	6,6	2,3
Fuel				0,0	0,0
Other variable costs	1000	600	600000	3,0	1,0
Sub-total variable cost			9733500	47,9	16,2
Total cost (without financial cost)			20316534	100,0	**33,9**
Financial cost			8577144		14,3
Total cost (including finances)			**28893679**		
Milling cost per Kg of green coffee			**48**	FRW / Kg Green coffee	
Opportunity cost of using his own capital			4288572		
Milling cost per Kg, opportunity cost included			**41**		

Working at full capacity, the operating costs per Kg of green coffee are :

- Cost excluding bank interest: 34 FRW / Kg;
- Cost including local bank interest: 48 FRW / Kg;
- Cost estimate using opportunity cost of capital: 41 FRW / Kg.

Sensitivity analysis and conclusions

The milling unit of 600 t capacity per year offers a quasi industrial processing service for fully washed coffee. It may operate using full capacity, but for a transitory phase, below its standard (as low as 200 t per year), and later on, over its standard (up to 1 200 t per year). The outcome in term of milling costs per Kg will be much affected by the level of capacity used, as shown in Table 22.

Table 22 - Sensitivity analysis according to tonnage milled, unit of 600 tons

Tons of green coffee Milling cost FRW/Kg	200 t	400 t	**600 t**	800 t	1000 t	1200 t
Financial cost excluded	68	42	**34**	30	27	25
Financial cost included	110	64	**48**	40	36	33

An analysis has been made for a unit of 1 000 t capacity using essentially the same set of equipment with an addition of handling and storage capacity. Such a unit can process up to 2 000 t per year. The sensitivity analysis of that milling unit is presented in table 23.

Table 23 - Sensitivity analysis of using the milling capacity, unit of 1000 tons

Tons of green coffee Milling cost FRW/Kg	500 t	800 t	**1000 t**	1200 t	1500 t	2000 t
Financial cost excluded	37	30	**27**	25	24	22
Financial cost included	54	40	**36**	33	30	27

The 600 t coffee milling unit presents a real interest for a group of several CWS deciding to develop common milling and grading capacities, as an alternative to the use of existing milling services from export operators, for the following reasons:

- Investment of 85 M.FRW, still moderate if it concerns 4 or 5 washing stations. The investment for a 1000 t capacity is not notably higher.
- Low unit cost when using full capacity (600 t or 1000 t) relative to smaller units;
- Still a high sensibility to the capacity level used:
  - Prohibitive cost for less than 400 t of processed coffee per year;
  - Low cost for 1000 t or more of processed coffee per year.

6. Comparison between alternatives

To make an overall comparison between milling options, we consider the amount of investment for each unit, the milling cost per Kg of green coffee (with and without financial costs) and an evaluation of the curing losses.

Differences of a few points in the curing losses and in the broken beans greatly affect the outcome of the comparison. For a difference of 5 % curing loss between the average performance of the existing capacities and a new 200 t milling unit, the cost equivalent to be added per Kg is of 37,5 FRW, corresponding to an annual loss for the washing unit of 7,5 M.FRW per year for 200 t of green coffee. On this differential loss hypothesis, a washing station of 200 t capacity could pay its own milling unit in 3 years.

Table 24 provides appropriate data to make a comparison between different milling options. It should be noted that using an average rate of curing losses as observed on standard semi washed coffee, the existing capacity option is probably negatively biased. Few well managed milling units propose services for fully washed coffee milling which can match the low level of curing losses obtained with new equipment.

Table 24 - Comparison between coffee dry milling options

Dry milling options	Investment	Milling cost	Milling cost	Curling	Curling loss	Overall
	Cost	FRW/Kg*	FRW / Kg*	Losses %	FRW/Kg	cost
	M.FRW	(including fin.)	(Exclud. Fin.)	**	(/ 200t)	(Exclud. Fin.)
Existing capacities						
Average service offered /Kg			70	23%	37,5	107,5
(Minimum - Maximum)			(45 - 95)			
New investments						
- Unit of 50 t capacity	25	152	103	18%	0	103
- Unit of 200 t capacity	33	59	42	18%	0	42
- Unit of 600 t capacity	85	48	34	19%	7,5	41,5
- Unit of 1000 t capacity	85	36	27	19%	7,5	34,5

* Not including bags
** Slightly lower yield for bigger capacity to take account of management difference and of longer series.

7. Conclusion

Most of the existing coffee milling units are offering a service to the fully washed coffee stations. Some of them propose these services at a very competitive price. But generally the services offered are not very attractive because of :

- High milling costs, up to 90 FRW per Kg of green coffee or more;
- Currently high curing losses due to bad management or poor maintenance of equipment.

For a fully washed station, the temptation to build its own milling facility is great, but that decision should be made after a careful appreciation of what the coffee washer needs, what the market is offering and the individual's access to financial resources, because a milling unit :

- Needs a significant investment (from 33 M.FRW for a 200 t capacity to 85 M.FRW for a 600 to 1000 t capacity);
- Requires good management;
- Can only be profitable if it runs at capacity.

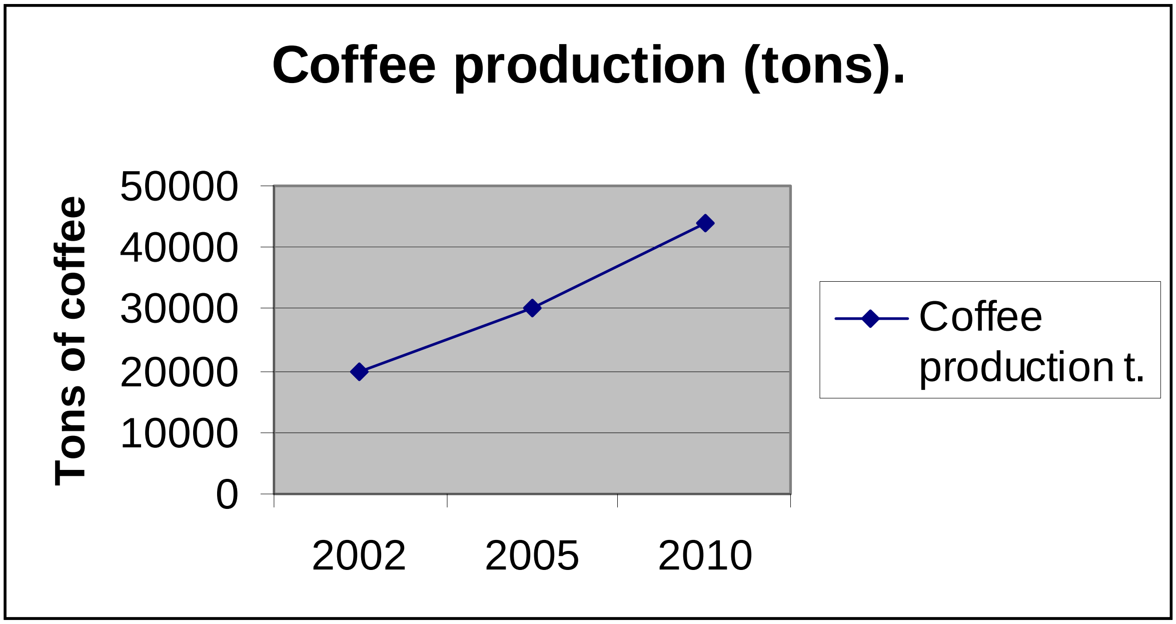
The consultants propose an analytical framework for CWS owners to develop an appropriate business decision strategy. This framework may be divided into two phases:

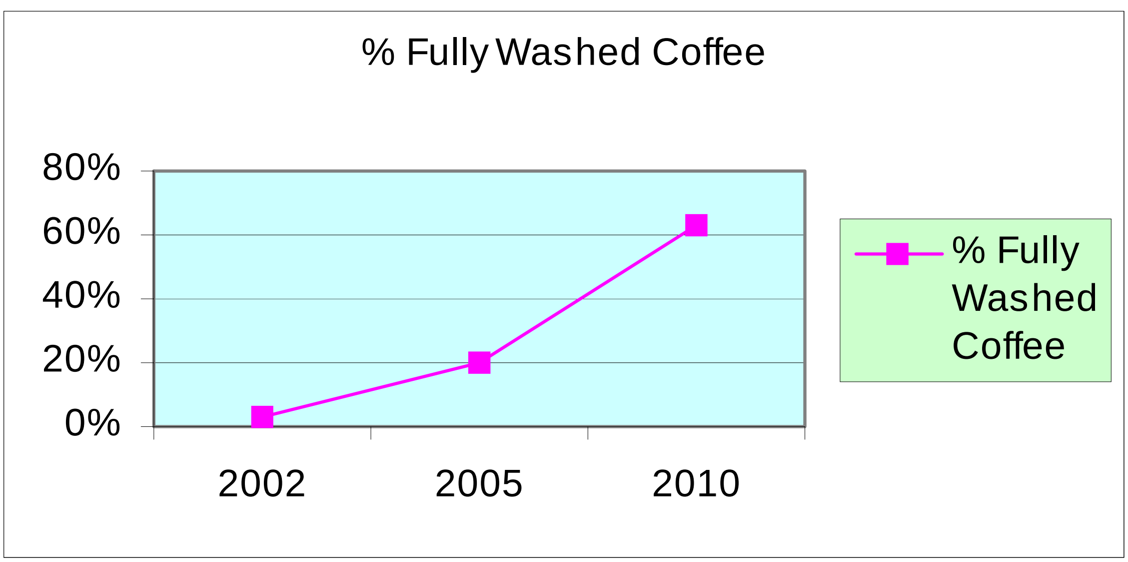
- 1st phase: During the first three years of operating the Fully Washed Unit, when the production remains below the objective capacity:
  - Enter in negotiation with existing milling units to buy the processing service according to your own requirement;
  - Bring the milling units into competition insisting more on service quality and lower losses than on price per kg of green coffee;
  - Develop, if possible, a good relationship with the selected milling unit for the first three years of fully washed coffee production.
- 2nd phase: After three years experience with a milling station:
  - Decide if the relationship with the milling unit has given satisfaction to both parties and continue using the processing service of that unit.
  - Alternately, decide to create one's own facility, building up a milling and grading unit adjusted to the washing station current and/or expected parched coffee production.
  - Select another alternative which would be to contract with several nearby washing units in order to build a common milling unit taking account of the group requirement in terms of capacity and quality criteria.

APPENDICES

Appendix 1. Rwanda coffee projections (2002 – 2010)

Source: Ministry of Agriculture, Animal Resources and Forestry. A new Strategy to revitalise Rwanda's coffee sector. May 2002.





Appendix 2. Tanzania coffee board test 2000.09.14

Peter Jones Consultants Limited
PO Box 476 NJOMBE
Tanzania **16.09.2000**

The following shows the results of trial hulling using a JOHN GORDON LIMITED AH-4 huller carried out by the TANZANIA COFFEE BOARD's (TCB) Technical Manager, Mr David Kiangi in the presence of: Mr Peter Jones of Peter Jones Consultants Limited and Mr Dilip Pattni, Director of Soochak, Bush and Tropex Ltd on 14th September 2000 in MBINGA

Parchment Hulled	100 kgs	
Clean Coffee **before** grading	83,5 kgs	
Clean Coffee **after** grading	83,21 kgs	

	Screen	Kilograms	%	
AA	18	27,100	32,57%	
A	17	25,800	31,01%	
B	16	18,400	22,11%	
PB	14	3,700	4,45%	75,00
C	15	7,150	8,59%	82,15
E	20	0,100	0,12%	
F	13	0,624	0,75%	
F	12	0,142	0,17%	
TEX	Below 12	0,072	0,09%	
AF	AF	0,106	0,13%	
	Spillage	0,016	0,02%	
		83,210	100,00%	

	Kgs	%
Solid beans	82,150	98,73%
Grinders	1,044	1,25%
Spillage	0,016	0,02%
	83,210	100,00%

Brokens	0,214	0,26%

CURING LOSS PRIOR to grading	**16,50%**

CURING LOSS **AFTER grading**	**16,79%**

Appendix 3. Tanzania coffee board test 2000.12.30

From:
Peter Jones Consultants Limited
PO Box 476 NJOMBE
Tanzania

The following shows the results of initial trial curing using a John Gordon Ltd AH-0 H huller, Palini-Alves PORTO 1-2 Grader and four Palini-Alves PP-CH4 Catadors carried out by Peter Jones in the presence of: Mr A V Mapunda of Soochak, Bush and Tropex Ltd on 30th December 2000 in MBINGA

Parchment Hulled	Class 8	1 000	kgs	= 20 Bags of P1
Clean Coffee **after** grading		812	kgs	

Grader Outlet #	Grader Screens	Size	Screen	Kilograms	%	
1	18 round	AA	18	283,000	34,85%	
2	17 round	A	17	256,000	31,53%	
3	11 slotted	PB	PB from 17	99,000	12,19%	
4	16 round	B	16	103,000	12,68%	91,26%
5	10 Slotted	PB	PB from 16	5,000	0,62%	91,87%
6	15 round	F	15	37,000	4,56%	
7	14 round	F	14	7,000	0,86%	
8	Below 14	TEX	Below 14	14,000	1,72%	
		// Samples taken		3,000	0,37%	
			*Spillage	5,000	0,62%	
				812,000	100,00%	
					100,00%	

CURING LOSS = 18,80%

***<u>AFTER</u> grading <u>AND</u> Catadors

BROKEN BEANS = Negligible !